



ATMOSPHERIC SCIENCE

The master's degree research in atmospheric physics may be directed in several areas: to transition meteorological principles into weather forecasting and climate decision aids, to provide assistance to the Air Force Weather community in validating proposed operational models, or to examine the possible operational relevance of newly published theories. The annual call for research requests results in numerous topics annually. While most are from the Air Force Weather Agency and its center, the AF Combat Climatology Center, the responses from the Operational Weather Squadrons (OWS) forecast centers are notable as well as many other AF Weather units. Not only do a significant number of these proposed topics represent outstanding problems to be addressed as graduate research, in many instances the results are factored into the formulation of high-level decisions having immediate feedback on operations or the acquisition process.

AF Weather (AFW) thesis topics are gathered each year and prioritized by HQ AF/XOW. Atmospheric physics master's students then pick from the most important topics on the list. Typically, these topics satisfy critical research needs within AFW and at units to which AFW officers are assigned after their AFIT tour.

We have conducted research dealing with lightning forecasting and other severe weather events for the 45th Weather Squadron at Cape Canaveral, Florida. The emphasis of these efforts is directed toward improving the launch forecasts, especially for the Space Shuttle. Both real-time forecasting techniques and climatological studies of different weather events have helped to reduce the need for last minute cancellation or delay of launches. This is vital since each delay can cost over \$100K and cancellations can be even more expensive.

The accuracy of state-of-the-science contrail forecasting is of critical concern to stealth aircraft operations. The 88th Weather Squadron, which supports Aeronautical Systems Center, has been the focal point of this area for improving weather support to these weapon systems. In addition to testing new forecast algorithms, past research has included the collection of new contrail databases, analysis of the capability to predict the minimum altitude at which contrails form, and the determination of the critical weather parameters required to improve our forecasting ability.

Another ongoing area of research in support of the Air Force Research Laboratory is the quantification of weather effects on laser imaging radar. OWS units are responsible for providing forecasts in support of precision guided munitions and unmanned aerial vehicles. The impetus of this research is to determine the weather parameters and thresholds that would impact the use of these developing weapon systems.

Current applied climatological research focuses on the challenge of long-range weather forecasts and model verification. These efforts support the Air Force Combat Climatology Center as well as the forecast challenges faced by the OWS units. Both statistical and data mining/pattern recognition efforts are being explored in this effort to produce predictive forecast tools.

Research is also ongoing in the area of numerical weather prediction in support of Air Force Weather Agency. This research includes an investigation of the impact of data denial on the accuracy of battlefield-scale numerical forecasts, a study of potential improvements in numerical wind gust forecast algorithms, and an examination of surface physical parameterizations for high latitude theaters. This research is conducted using the multi processor version of the Mesoscale Model 5 (MPP MM5) run either on a 32-node Unix workstation clusters in the AFIT weather laboratory or on the IBM SP-3 at the Aeronautical Systems Center Major Shared Resource Center.

FACULTY:

Huffines, Gary R.

Assistant Professor of Atmospheric Physics

B.S., Ohio Northern University, 1983; M.S., Utah State University, 1990; Ph.D, Texas A&M University, 1999.

Atmospheric effects on the propagation of electromagnetic radiation and lightning.

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B.S., Computer Science, Chapman College, 1983; M.S., Meteorology, Texas A&M University, 1989; Ph.D., Meteorology, Texas A&M University, 1998. Applied climatology, synoptic meteorology, mesoscale meteorology, general circulation and global climate, and weather effects on DoD weapon and reconnaissance systems.

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B.S., Zoology, Texas A&M, 1976; M.S., Meteorology, Texas A&M, 1985; Ph.D., Meteorology, Texas A&M, 1988.

Dynamics and numerical weather prediction.

SOME RECENT PUBLICATIONS:

“Regional Verification of the Polar MM5 over Alaska,” Preprints, 15th Conference on Numerical Weather Prediction, San Antonio, Tx., Amer. Meteor. Soc., 222-225, August 2002, Courtemanche, William E. and M.K. Walters.

“Designing an Algorithm to Predict the Intensity of the Severe Weather Season.” Preprints, 13th Conference on Applied Climatology, Portland, Oregon, Amer. Meteor. Soc., May 2002, Freestrom, Hugh J. and R. P. Lowther.

“GPS-derived integrated Precipitable water compared with AFWA MM5 moisture fields”. Sixth Symposium on Integrated Observing Systems, Orlando, Florida, 13-17 Jan 2002, Vollmer, P.A. and G.R. Huffines.

“Comparison of MM5 convective precipitation forecasts with cloud-to-ground lightning information in the CONUS Intermountain West”. Sixth Symposium on Integrated Observing Systems, Orlando, Florida, 13-17 Jan 2002, Walters, M.K. and G.R. Huffines.

“Determining the distance lightning travels from a thunderstorm using ground based radar, the National Lightning Detection Network, and a 3-D lightning mapping system”. Sixth Symposium on Integrated Observing Systems, Orlando, Florida, 13-17 Jan 2002, Nelson, L.A., T.M. McNamara, D.R. Vollmer, and G.R. Huffines.

“GPS-derived integrated precipitable water compared with AFWA MM5 model output”. 11th Conference on Satellite Meteorology and Oceanography, Madison, Wisconsin, 15-18 October 2001. Vollmer, P.A. and G.R. Huffines.

“North American Lightning Detection Network (NALDN) first results: 1998-2000”. American Geophysical Union Fall Meeting, San Francisco, California, 10-14 December 2001, Orville, R.E. and G.R. Huffines.

“Twelve years of cloud-to-ground lightning characteristics, 1989-2000: Small scale results”. American Geophysical Union Fall Meeting, San Francisco, California, 10-14 December 2001, Steiger, S.E. Phillips, R.E. Orville, and G.R. Huffines.

“The horizontal distance of cloud-to-ground lightning”. American Geophysical Union Fall Meeting, San Francisco, California, 10-14 December 2001, McNamara, T.M. and G.R. Huffines.

“The distance lightning travels from a thunderstorm based on altitude and atmospheric temperature”. American Geophysical Union Fall Meeting, San Francisco, California, 10-14 December 2001, Vollmer, D.R. and G.R. Huffines.

“A simple example of Galilean invariance in the omega equation,” *Bulletin of the American Meteorological Society*, Vol. 82, No. 3, 463-472, 2001, Walters, Michael K.

“Investigation of the Correlation Between Mechanical Turbulence and Optical Turbulence in the Atmosphere,” Preprints, 11th Symposium on Meteorological Observations and Instrumentation, Albuquerque, NM, Amer. Meteor. Soc., January 2001, Early, Steven A. and M.K. Walters.

“A comparison of exhaust condensation trail forecast algorithms at low relative humidity,” *Journal of Applied Meteorology*, Vol. 39, No.1, pp. 80-91, 2000, Walters, Michael K., J.D. Shull, and R.P. Asbury III.

“On the use of neural networks and conditional climatology to predict peak wind speed at Cape Canaveral’s Atlas launch pad,” Preprints, Ninth Conference on Aviation, Range, and Aerospace Meteorology, Orlando, FL, Amer. Meteor. Soc., 182-187, 2000, Cloys, Kenneth P., M.K. Walters, L.K. Coleman, and W.P. Roeder.

“Analyzing the Planetary Boundary Layer in Transport and Diffusion Atmospheric Modeling: A Four Algorithm Comparison”, Preprints, Air and Waste Management Association 92nd Annual Meeting, June 1999, Russ, Robert L., D. Dean, and M.K. Walters.

“A validation study of the Air Force Weather Agency (AFWA) JETRAX contrail forecast algorithm,” Preprints, Eighth Conference on Aviation, Range, and Aerospace Meteorology, Dallas, TX, Amer. Meteor. Soc., 591-595, 1999, Walters, Michael K., and J.D. Shull.

“Calibrated probabilistic quantitative precipitation forecasts based on the MRF ensemble,” *Weather and Forecasting*. Vol. 13, No. 4, pp. 1132–1147, 1998, Eckel, F. Anthony and M.K. Walters.